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(54) A Respirator for Clinical Use

(57) A respirator comprises a pneumatic module and a control module 6. The pneumatic module comprises manifolds 2—4, connected to supplies of compressed gases, and to a pneumatically operated pressure equilibrator 21 which is connected to a mixing chamber 22, controlled by a dual pressure switch 26, which supplies batterys of valves 7, 16 having stepped series-connected resistances signalling the control module 7. Battery 7 forms an inspiration valve assembly and incorporates a flow transducer 15, while the other controls the expiration valve 7. The control module 6 comprises a microprocessor 35 incorporating a keyboard 38 and a VDU40 simultaneously showing alpha-numeric and graphic information. The information to the control module 6 from the pneumatic module passes through amplifying blocks 42, 43, 44 and A/D converters which are connected to buses of the microprocessor 35. The data buses are also connected to a plurality of optical couplers and amplifiers 46 to 49 which produce signals for controlling the various valves and members of the pneumatic module.

Fig. 1.

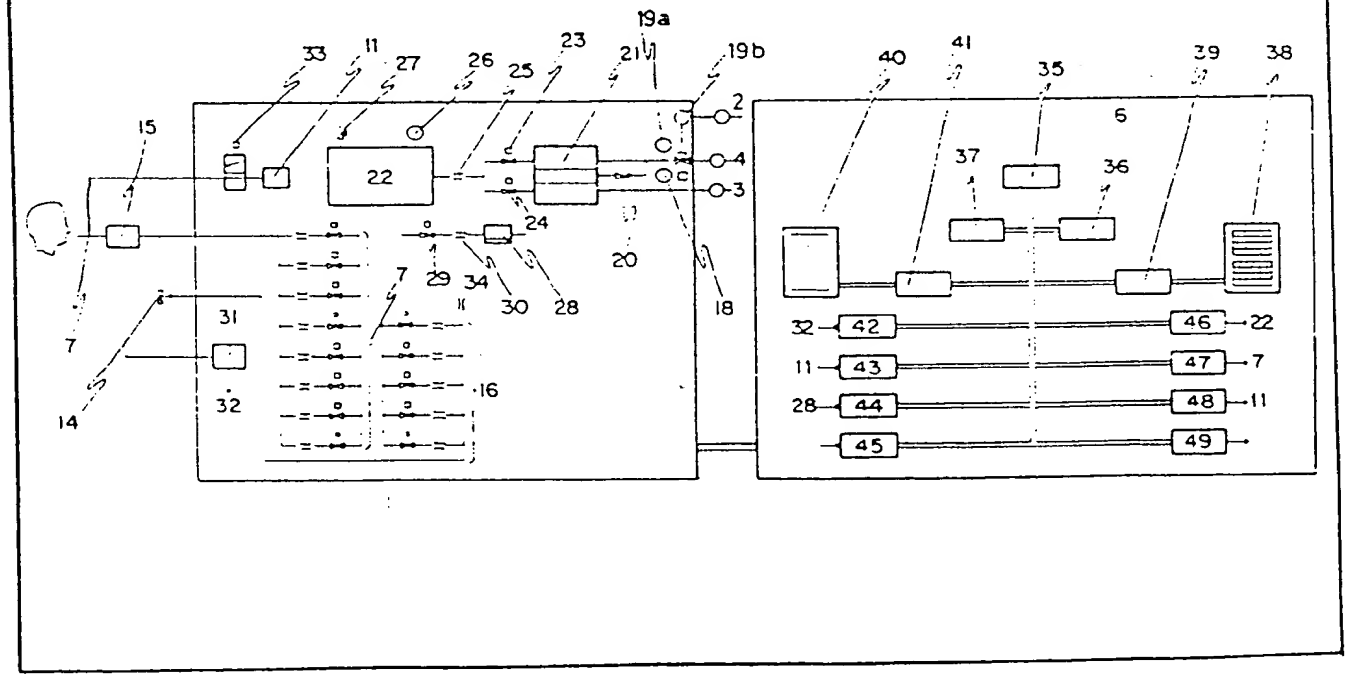

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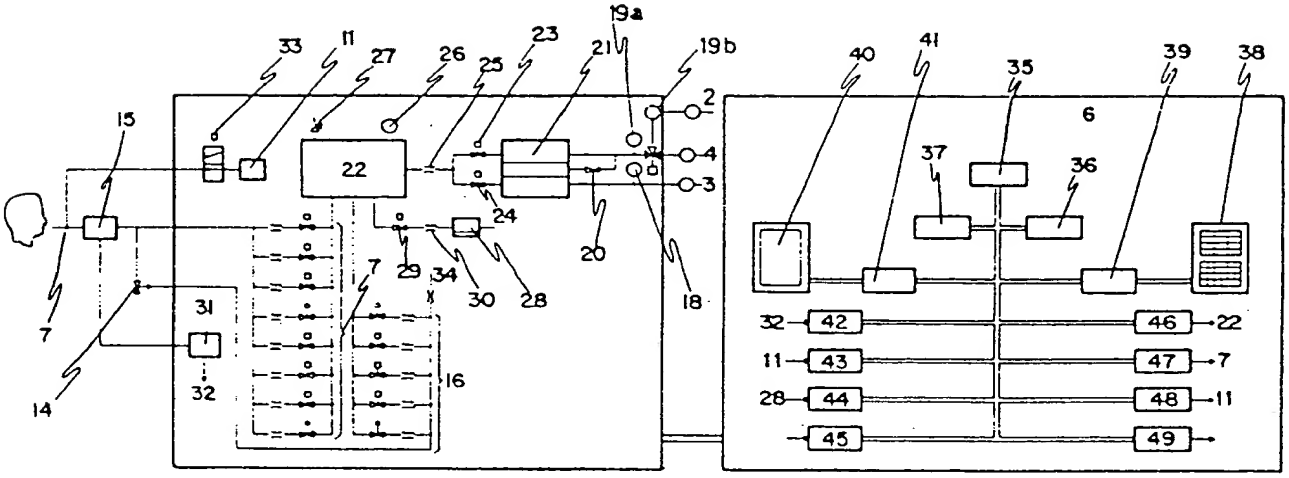
FIG. 1.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SPECIFICATION

Improvements Introduced in a Respirator for Clinical Use

The present invention relates to improvements introduced in a respirator for clinical use.

The respirator made in accordance with the improvements of the instant invention can be universally used having a maximum utility in adult, child and new-born infant intensive care and resuscitation units, which can be used in all the phases and modalities of treatments with artificial ventilation, and having the important advantage that all the accessories normally used in this type of treatments are integrated, forming part of the basic equipment which, in practice, forms the respirator.

The improved respirator, object of this invention, basically comprises two main modules which will hereinafter be referred to as:

Pneumatic Unit
General Control Module

The general control module contains a microprocessor, preferably of 8 bits, including all its accessory and peripheric circuits, this microprocessor being controlled by various pneumatic and electromechanical controllers from a plurality of data proportioned by the appropriate sensors arranged throughout the pneumatic unit. This control takes place following the programmed instructions registered in permanent memories cooperating with the microprocessor. As the intercommunicating element between the operator of the respirator and the general control module, there is provided a key-board which permits data and instructions to be introduced and a cathode-ray screen capable of simultaneously reflecting alpha-numerical data and graphic representations, by means of which the performance and effectiveness of the respirator is highly improved when compared with conventional respirators.

The pneumatic unit, in turn, comprises the respective manifolds for supplying gases compressed at the pressures normally used in hospitals, as well as a mixer and a mixing chamber to proportion the patient with the appropriate amount of gases, and a plurality of valves, flow transducers, pressure regulators, etc., all of which are duly interrelated with the control module to transmit and receive the adequate information which permits the complete automization of the respirator.

More specifically, the pneumatic unit comprises:

a) a gas mixer
b) a mixing chamber
c) an inspiration valve
d) an oxygen analyzer
e) a flow transducer
f) a system for controlling an expiration valve
g) an expiration valve
h) a system for measuring the patient's pressure
i) measuring and safety systems.

All these members, as previously mentioned, are duly interrelated through the corresponding optical couplers, analyzers, sensors, or other element to the general control module which is controlled by a main processing unit based on a microprocessor.

The supply of gas proportions the gaseous mixture to be supplied to the patient, regulating the composition and pressure thereof with the help of a gas mixer. The gas mixer makes the air/O_2 or O_2/N_2O mixture from the corresponding gases under pressure which reach same through the suitable manifolds, the process used preferably consisting in controlling the relative times of the passage of each gas through the same fixed resistance. In this respect, it should be pointed out that the preferred embodiment uses the time controlled mixer, object of Spanish Utility Model 231,608.

The mixing chamber serves as a gas accumulator so that elevated instantaneous flows are obtained, besides permitting the homogenization of the mixture of gases.

From the mixing chamber there protrudes a manifold which reaches a battery of valves forming the assembly of the inspiration valve. This inspiration valve comprises the end controller of the servo-system which regulates the rate of inspiration to the patient, depending on the signal transmitted thereto by the flow transducer and on the instantaneous value necessary at each moment. The practical realisation of this inspiration valve is, as previously mentioned, a battery of valves with a digital stepping.

Inserted in the manifold which supplies the mixture of gases to the patient, there is a flow transducer, an element which permanently sends information to the general control. This transducer has a bidirectional character, it has a low charge loss and a rapid reply.

The expiration valve consists of a pneumatically operated membrane valve. The election of the pneumatic operating system is preferred due to the simplicity reliability and lightness thereof.

The pneumatic controller of the expiration provides the pneumatic signals for the control of the expiration valve, depending on the electrical signals received from the general control. It uses O_2 or compressed air as the pneumatic supply.

The system for measuring the patient's pressure is formed of a pressure transducer and an electrically controlled three-way valve which permits the transducer to be periodically placed in communication with the atmosphere, to automatically measure same.

Finally, there are various elements, such as pressure switches, filters, and unidirectional safety valves which function as auxiliary measuring, controlling and safety elements.

With respect to the general control module, it can be said that same monitors all the elements of the system depending on the input signals, so that the functions requested and which are contained, in a programmed manner, in the

in all the possible assisted and controlled modes of respiration, as well as variations and combinations.

6. Improvements introduced in a respirator for clinical use, according to Claims 1 and 5, characterised in that the control module has recorded in a memory a program of simulation of the reply which will be obtained in the clinical variables of the patient as a result of the change of the operating parameters controlled, in this moment, by the respirator and which simulation of reply is obtained on the cathode ray screen without producing variation in the actual operating parameters.

7. Improvements introduced in a respirator for clinical use according to Claims 1, 5 and 6, characterised in that the cathode ray screen presents, in the form of stable curves, the curves corresponding to pressure, volume and instantaneous flow, which relative data are temporarily stored in a memory controlled by the controller inherent to the screen.

8. Improvements introduced in a respirator for clinical use according to Claims 1, 5, 6 and 7, characterised in that the control module has a determined memorizing zone for accumulating the different clinical parameters of the patient for a certain period of time in order to form a data bank or clinical history of the patient.

9. Improvements introduced in a respirator for clinical use according to Claims 1, 5, 6, 7 and 8, characterised in that the control module has recorded in a memory a program which controls the keys of the keyboard, so that this should always be operated in a defined sequential manner, simultaneously checking the proposed values following certain computered patterns, not permitting the proposed parameters which may lead to erroneous combinations or abnormal values thereof to be accepted by the machine.

10. Improvements introduced in a respirator for clinical use according to Claims 1, 5, 6, 7 and 8, characterised in that the control module has permanently registered in a memory, certain basic operating parameters which the equipment proposes to the operator at the initial moment of the connection thereof.

11. A respirator for clinical use substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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